DAMAGE DETECTION OF RAGHUNATH PALACE – A CASE STUDY OF SURGUJA PROVINCE

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Abstract : Buildings are present since many years ago and as the times passes buildings too are changing due to innovation and technological development. But its base is same all the innovation is derived from the past construction practices. In these paper ancient buildings, its construction weathering action and rehabilitation method has been discussed by studying the ancient building located in Ambikapur City of Surguja District of State Chhattisgarh India. Here, ancient buildings are present since emperor's rule over India. The Reason of study being that at the time of construction, innovation and technologies were not much improved and ancient building materials were used for construction but the structures are still withstanding and are in use with good condition even with the defect and weathering action. The paper consists of damages and its causes to the ancient structure.

Index Terms **- Raghunath Palace Ambikapur, Circuit House, Collectorate, ancient structures**

1. INTRODUCTION

The Study of Ancient building is important because it give us ideas about our ancestors as well as their living styles. The Building of Surguja Province are Very important structures of the state because they not only show our wealth but also the engineering techniques that they are still prevailing in the world and serving the people.

1.1 LOCATION- Surguja province is one of the highly rich princely state at the time of rulers ruing over India. It is located in northern part of Chhattisgarh state, India. Its neighboring states are Uttar Pradesh, Madhya Pradesh, Orissa, and Jharkhand. Its coordinate of location in globe is 23^0 37' 25'' To 24^0 6' 17'' north latitude and $81^0$34'40'' To 84^0 4'40'' east longitude. It is about 244.62 Km from east to west and 167.37 Km from north to south and covers an area of about 18188.44 Km^2 out of which 10849.079 Km^2 is forest area. Tropic of cancer result in high pressure belt but due to its height from MSL there is control in temperature of the area.

Fig 1 – Map of Surguja District

1.2. CLIMATE- The climatic condition of area is hot summer with distributed rainfall in monsoon. It came under Tropical Thermal belt. It has long dry period with temperature rising over 18^0 C and maximum up to 46^0 C. During winter it went below 18 ^{0}C. It has sufficient rains during rainy seasons. Climatic condition of area is determined by its shape, size, extent and central system of high lands and uplands. Annual rainfall is around 1314 mm. Relative humidity is 76-92% throughout year. Wind speed in the area is not more than 20 Km/hrs.

1.3. SEISMIC HAZARD- Surguja lies in zone III with regard of seismic activity. No major earthquake has been recorded yet. Instead it has observed shaking effect due to earthquake in neighboring state.

1.4 FAULT ZONE- Tatapani fault is present in east-west direction of Manpura. Godavari fault in southern part of state.

2 IMPORTANCE OF STUDY-Today many technologies are present to construct any structures easily and quickly. But durability of the structures is limited. In India there are many structures which are present and are highly significant from decades. In Surguja District of Chhattisgarh state many of the ancient structure are still prevailing. They are still very important because they are not only just the ancient structure but a remarkable memory of our heritage.

The structures have damaged a lot but if maintenance were done earlier they can with stand many more year and serve our state. Ambikapur Palace namely The Raghunath Palace is the oldest historical building in the surguja state. It was the royal princely State at that time. The palace is a two stories building with 7 courtyards. It is white in colour. Its location is $23^0$6'58"N $83^0$11'38"E.

The construction of front portion was started in the year 1922 and completed in the year 1925. During the rule of Honorable King Ramanuj Saran Singh Deo. When India got freedom all the possession was handed over to the government. Collectorate building too was a part of Palace which is presently the Collectorate of Ambikapur without any remarkable changes.

Fig 2 – The Raghunath Palace Ambikapur (Present view)

3 SURGUJA RESIDENCY AND ITS IMPORTANT STRUCTURES

In Surguja District there are many ancient structures which are withstanding from many era, and are now been used up by the government for their offices, and other purpose.

A) The Raghunath Palace- A place of Heritage,
B) Raghunath combined high court & court Building-presently the Collectorate Parisar.
C) Raghunath Son's palace-presently The Circuit House,
D) Rastrapati bhawan pandonagar-presently at Surajpur district
E) Mahamaya Temple
F) Raghunath Hospital 1931-presently The Government Hospital of Ambikapur and Doctor's Quarter
G)- Bridges- Surajpur Bridge over River rehar, Karabel Bridge, Pratapgarh Bridge Etc. built by Gaiman company during 1945-46 and few timber bridges.
H) Kothi ghar, presently the residence of Mr. T.S. Singh Deo Family.
I) Edward High school presently Multipurpose school built in1914.
J) Raja Palace of Baikunthpur Korea.

Fig 2 Collectorate Building

Fig 3-Raghunath Government Hospital Part

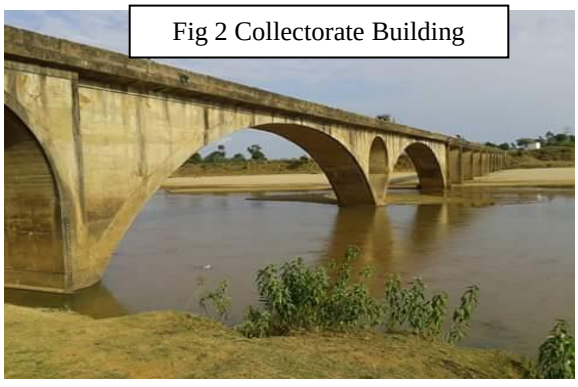

Fig 4 – Bishrampur Surajpur Bridge over River Rehan

Fig 5- Bridge constructed by Mr. Ramanuj Saran Singh Deo Maharaj

Fig 6- Kumar's Palace at Baikunthpur

Fig 7 – The Raghunath Palace (Olden days)

4. DETAILS OF STRUCTURE

Surguja residency at the time of kings and queens was one of the Royal Princely state of India. The Raghunath Palace is the best example which shows our heritage. It was built in the year 1922-1925 (front portion). The Collectorate, Circuit house, Multi purpose School too was the buildings belonging to the kings of the state. But today it is used as governmental buildings without much renovation as the building is still in good condition.

Now the question arises how the ancient building withstanding in surguja giving their remarkable performance. The answer is in the construction technique used in olden days. In olden days no RCC construction were made but naturally available materials were used for the construction even though it takes lots of investment and hardship.

4.1 **CONSTRUCTION MATERIAL-** As the palace was made long years ago ancient technologies and materials were used for its construction. Huge amount of labors were involved along with animals which help in transportation of materials from far distant place to surguja. Lime surkhi mortar was used as a binding material as at time cement was not introduced in India. Foundations are present deep inside the earth crust at about much larger depth because at that time people think that if we have to construct building double storey then the depth should also be large enough to overcome the instability cause by earthquake and wind. That is in our term for overcoming overturning moment. Width of foundation is more than 6 feet. Bricks are used as masonry unit, made up of clay burnt in open kiln. For the production of mortar, rehat is used in which animal is used for preparation of huge quantity of mortar. Wood, ceramics, glasses, lime, clay, surkhi, wood apple are the main building materials which are used in the palace. Sal Wood were used because at that time forest of surguja was very wide and *Shorea robusta* Commonly known as Sal is easily available. Glasses were imported from Belgium, and tiles from Italy. The Masons were from Rajasthan and Haryana and were highly skilled.

4.2 TYPES OF CONSTRUCTION- The palaces are load bearing, massive ancient structure with huge foundation lying deep inside soil and is made of bricks, lime surkhi mortar. Foundation bed is surely of stones for providing firm base to foundation. The mortar is lime surkhi with wood apple as filler so as to enhance the strength of structure. Roof construction is of Brick lying over wooden planks and plastered with lime surkhi mortar as binding materials. The stair case is designed by Wood. The entire stair component is made up of Sal wood whether it is nosing, steps, handrails or balustrade. The stairs are embedded in the walls at one side and at other it is supported by wooden short column at short spans. Flooring is of Italy imported Tiles fixed by lime. Whitewashing too is of lime and palace is purely white in colour.

5. **METHOD OF INSPECTION**- To study the detail of palace we visited the palace. We took permission from its owner Mr. T.S. Singh Deo presently the Panchayat and Health minister of Chhattisgarh. His fellow man Mr. Govind Shukla showed us the parts of palace and enlightens us with the knowledge he possesses. Visual inspection of this ancient structure is carried out and photographs has been clicked so that we can study more about the damages occurred in the structure and its construction detail.

6. DETAIL OF BUILDING-Measurement of structures is taken by us using tapes and certain information is given us by Mr. Govind Shukla Sir.

Table-1 Detail of surguja Raghunath palace

SL.NO	STRUCTURAL COMPONENT	DETAIL
1.	Type Of Structure	Load bearing massive structure
1.	Foundation	Very Deep foundation in order to withstand upper storey. Foundation width beyond 6 feet Laid over stone rubble masonry
2.	Wall	Brick wall, width-3'6" to 4'0"
	Mortar	Lime surkhi, sand with wood apple (bel) as admixture,4.5 cm thick
	Wall Component	Wood for decoration as well as strength

3.	Roof	Wooden planks-girder and purlins over them vertical bricks and lime surkhi plaster
4.	Floor	Italy Tiles with lime surkhi mortar as binder
5.	Stair Case	Sal wood stair, nosing hand rails, baluster Thread-0'11" Riser-0'8" Length-2'6"
6.	Arches	Wooden arches for windows and doors
7.	Glass	Belgium glass of transparent blue and green colour is used
8.	Decorative Component	Balcony designing precast molding technique is used
9.	Specialty	Air conditioning
10.	Distortion	Cracks, ground settlement, roof bend, maintenance effect, fire destruction.
11.	Doors	Huge size, sal wood, spring hoist
12.	Bricks	20X14.5X5 CM, 22X10.5X7 CM Colour-Orange, red, maroon
13.	Plaster	Lime Mortar
14.	Whitewashing	White lime

7. DAMAGING FACTORS OF RAGHUNATH PALACE

a) Physical Factors- Rainstorm, windstorm, temperature variance with moisture affect many portion of palaces. Moisture are the main deterioration agents of damage as it cause seepage and deterioration of materials of buildings.

b) Biological Factors- Small Plants, Mosses, algae, Fungus, Insects are the biotic agents which grow and damaged the building parts. In the palace grasses, Peepal tress due to bird beet has sprouted out at many places which when grow their roots exert pressure on the building blocks and thus damage the structure. Bats are peresnt in huge quantity which damage the structure and foul odour due to their presence make environment unpleasant

c) Chemical Factors- Air Pollutant, Sulphonation of limestone's, carbonation etc are the main damaging agents. Due to chemicals blackness on the wall are seen easily.

d) Human Negligence- Proper inspection and maintenance of the palace was not being done from so many years which is the main reason for palace deterioration. Proper cleaning, whitewashing repairing of those parts which are easily repairable were not done and left leading to further deterioration.

e) Settlement- The soil settlement due to all the above factors too is the most important cause of damage to palace. As in ancient times proper drainage were not set up and foundation bed were not lied according to soil bearing capacity there are chances of foundation sinking which is present in Ambikapur palace too.

f) Fire- Palace construction is mainly of wood and due to human fault short circuiting, the palace caught fire and got destructed. The Diospyros melanoxylon (tendupatta) godown also caught fire and spread to palace and in turn damage the structure.

8 DAMAGES IN BUILDING

a) Cracks-Hairline Cracks in Wall, Horizontal and Vertical Cracks at junction of roof slab and wall, Deep structural Cracks are present in the building at various part.

b) Settlement- Due to Seepage of Water the foundation at some places was settled down and slight sinking and tilting of wall section occurred.

c) Roof Collapse-Due to no maintenance and fire the wood of roof burnt and many portion of palace roof is collapsed.

d) Wall failure- Due to moisture, biological agents, fire and loading , differential settlement section of wall are collapsed.

e) Discoloration and bulging of plaster the wall get damaged. The white colour changes to yellow , black spots are present in the palace. Marble of palace become yellowish. This is due to deposits of salts, fungus and algae attack.

f) Damage to wood- due to moisture and white ants the wood of the palace get cracked and decayed al well as deformed.

g) Spalling- Moisture cause plaster spalling and air got struck in them and plaster flake got detached from the wall.

h) Biological colonization- Vegetation, microbes were present in the structure which made the structure their home and make cavity in the walls, create pores and cause scaling, cracks deep inside the structure too.

i) Material loss-plaster of roof and wall are detached from them. Floor tiles get detached due to seepage and binding material failure. Material loss not only affect the upper portion but also has affect on beneath the walls and this is the reason of wall failure.

j) Wood distortion- The wooden component of palace are destroyed by rotting up, fire, and by insects and mosses and ferns. And thus get broken down leading to roof collapsing.

9. IMAGES OF DEFECT AND DAMAGES IN RAGHUNATH PALACE

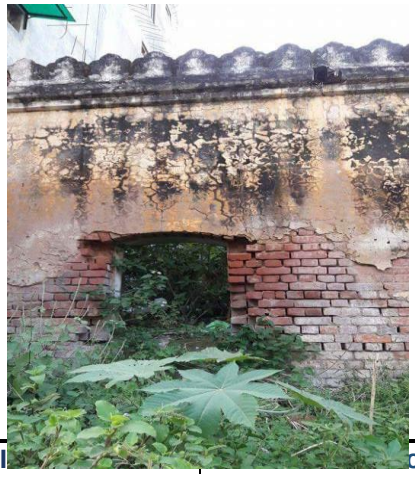

Fig 8-Plaster and wall damage, black patches due to chemical attack

Fig-9 Plant growth at the junction of marble temple and wall

Fig 10- Damages in structures like Structural cracks, Chemical attack, Algal growth etc.

Fig 11- Damages in Roof plaster

Fig 12- Slab edge deterioration due to mosses

Fig 13- Cracks and joint failure

Fig 14- Stair defects at Circuit

Fig 15- Spalling and moisture effect at Raghunath Palace

Fig 16- Settlement of Foundation effect

10. RESULT AND DISCUSSION- The Raghunath palace is really a remarkable structure of Surguja district, It has seen many environmental factors and withstand it but with damages on the structure. If the structure is maintained by its owner then the defects would not have been such a huge that its parts could collapse down. Mainly wall damage and plastering due to seepage and biotic factors were present in the building. The damages and defects are such that they can be repaired. Even though Reparation and Rehabilitation will required hard work but can be done without changing the importance and maintenance of homogeneity is surely possible.

11. ACKNOWLEDGEMENT- This research would not been possible without the Guidance of Mr. Vijay Shukla sir and Dr. N. P Dewangan sir. Actually the idea to research over traditional building arise in my mind after visiting the palace and other place in Surguja that how were they constructed when in ancient times what we are using today were not innovated.

12. SCOPE FOR FUTURE WORK- Based on the defect and damages occurred in the palace structure we can suggest and find out the most suitable method of the structure rehabilitation without changing the homogeneity of the structure and increasing the Palace durability. Suggestion and technique of Palace repair should be done accordingly.

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